We claim:

1. A process comprising the steps of:

(a) selectively exposing a polymer in an oxidizing atmosphere to actinic light, wherein:

(i) the polymer comprises a polymeric or copolymeric composition containing one or more functionalities that will photooxidize to carboxyl groups that remain bound to the polymer, when the polymer is exposed to actinic light in an oxidizing atmosphere;

(ii) the light selectively exposes portions of the surface of the polymer in accordance with a pre-determined pattern, while not exposing the remaining portions of the surface to substantial light;

(iii) the fluence of light in the exposed portions of the surface suffices to induce photooxidation of polymer on or near the surface, sufficient to generate substantial quantities of carboxyl groups that remain bound to the polymer, but insufficient to cause substantial photoablation of polymer in the exposed portions;

(iv) the fluence of light in the unexposed portions of the surface is zero, or is insufficient to induce the generation of substantial quantities of carboxyl groups that remain bound to the polymer;

(*v*) the surface of the polymer is essentially free of any photoresist that is responsive to the actinic light at the fluence in the exposed portions of the surface; and

(b) reacting the resulting, bound carboxyl groups with one or more reactants, to impart chemical functionality to the exposed portions of the polymer surface different from carboxyl functionality, while not imparting substantial amounts of the same type of chemical functionality to the unexposed portions of the polymer surface.

2. A process as recited in Claim 1, wherein the actinic light comprises ultraviolet light, deep ultraviolet light, or near ultraviolet light.

3. A process as recited in Claim 1, wherein the actinic light comprises visible light.

4. A process as recited in Claim 1; wherein the fluence of light in the exposed portions of the surface suffices to generate at least about 10^{-12} moles per cm^2 of carboxyl groups that remain bound to the polymer; wherein the fluence of light in the exposed portions of the surface is insufficient to cause photoablation of polymer deeper than about 250 nm; and wherein the fluence of light in the unexposed portions of the surface is zero, or is sufficient to induce the generation of not more than about 5×10^{-13} moles per cm^2 of carboxyl groups that remain bound to the polymer.

5. A process as recited in Claim 1, wherein the one or more reactants are selected from the group consisting of oligonucleotides, antibodies, antigen-binding portions of antibodies, antigens, enzymes, non-enzymatic peptides, and non-enzymatic proteins.

6. A process as recited in Claim 1, wherein the one or more reactants comprise a reduced or oxidized metal; or wherein said process additionally comprises the step of reacting the chemical functionality with a reduced or oxidized metal to bind the metal to the functionality.

7. A process as recited in Claim 6, wherein the reduced or oxidized metal is selected from the group consisting of copper, nickel, gold, silver, platinum, and palladium.

8. A process as recited in Claim 1, wherein the chemical functionality comprises at least one nitrogen, oxygen, or sulfur atom having a lone pair of electrons; and wherein said process additionally comprises the step of coordinating at least one reduced or oxidized metal atom to the nitrogen, oxygen, or sulfur atom's lone pair of electrons.

9. A process as recited in Claim 1, wherein the chemical functionality comprises at least one nitrogen, oxygen, or sulfur atom having a lone pair of electrons; and wherein said process additionally comprises the sequential steps of: **(a)** coordinating at least one oxidized metal atom to the nitrogen, oxygen, or sulfur atom's lone pair of electrons; and **(b)** reducing the coordinated metal atom *in situ*; whereby reduced metal is selectively bound to the exposed portions of the polymer surface.

10. A process as recited in Claim 1, wherein the one or more reactants are selected from the group consisting of metal oxides, ceramics, piezoelectric materials, and semiconductors.

11. A process as recited in Claim 1, wherein the one or more reactants are selected from the group consisting of amines, imides, azides, azo compounds, cyanates, alcohols, thiols, anhydrides, and thionyl halides.

12. A process as recited in Claim 1, wherein: **(a)** the one or more reactants comprise a second polymer; or **(b)** the one or more reactants comprise a polymer initiator or a monomer, and said process additionally comprises the step of forming a second polymer bound to the first polymer *in situ* by reaction of monomer with the bound initiator or bound monomer.

13. A process as recited in Claim 1, additionally comprising the step of binding one or more whole, respiring cells to the chemical functionality on the polymer.

14. A process as recited in Claim 1, wherein the polymer is selected from the group consisting of acrylate polymers, aromatic polymers, polyimides, polycarbonates, and polysulfones.

15. A process as recited in Claim 1, wherein the polymer comprises a polysulfone.

16. A process as recited in Claim 1, wherein the polymer comprises poly (methyl methacrylate).

17. The product of the process recited in Claim 1.

18. The product of the process recited in Claim 2.

19. The product of the process recited in Claim 3.

20. The product of the process recited in Claim 4.

21. The product of the process recited in Claim 5.

22. The product of the process recited in Claim 6.

23. The product of the process recited in Claim 7.

24. The product of the process recited in Claim 8.

25. The product of the process recited in Claim 9.

26. The product of the process recited in Claim 10.

27. The product of the process recited in Claim 11.

28. The product of the process recited in Claim 12.

29. The product of the process recited in Claim 13.

30. The product of the process recited in Claim 14.

31. The product of the process recited in Claim 15.

32. The product of the process recited in Claim 16.

33. A composition comprising:

(a) a polymer substrate;

(b) carboxyl or carbonyl groups selectively bound, in a predetermined pattern, on or near the surface of the polymer substrate;

(b) chemical functionality that is different from carboxyl functionality and different from carbonyl functionality, and that is bound to said carboxyl or carbonyl groups, but that is not bound in substantial amounts to the portions of the polymer surface lacking substantial amounts of said carboxyl or carbonyl groups.

34. A composition as recited in Claim 33; wherein, within the predetermined pattern, the total concentration of bound carboxyl and carbonyl is at least about 10^{-12} moles per cm^2; wherein said predetermined pattern containing the bound carboxyl or carbonyl is not ablated more than about 250 nm compared to the immediately surrounding portions of the surface outside said pattern; and wherein, outside said pattern, the total concentration of bound carboxyl and carbonyl is not more than about 5×10^{-13} moles per cm^2.

35. A composition as recited in Claim 33; wherein said chemical functionality is selected from the group consisting of oligonucleotides, antibodies, antigen-binding portions of antibodies, antigens, enzymes, non-enzymatic peptides, and non-enzymatic proteins.

36. A composition as recited in Claim 33; wherein said chemical functionality comprises a reduced or oxidized metal.

37. A composition as recited in Claim 36, wherein said reduced or oxidized metal is selected from the group consisting of copper, nickel, gold, silver, platinum, and palladium.

38. A composition as recited in Claim 33, wherein said chemical functionality comprises at least one nitrogen, oxygen, or sulfur atom having a lone pair of electrons; and at least one reduced metal atom coordinated to said nitrogen, oxygen, or sulfur atom's lone pair of electrons.

39. A composition as recited in Claim 33, wherein said chemical functionality is selected from the group consisting of metal oxides, ceramics, piezoelectric materials, and semiconductors.

40. A composition as recited in Claim 33, wherein said chemical functionality is selected from the group consisting of amides, imides, azides, azo compounds, cyanates, esters, thiol esters, anhydrides, and carboxylic acid halides.

41. A composition as recited in Claim 33, wherein said chemical functionality comprises a second polymer.

40. A composition as recited in Claim 33, additionally comprising one or more whole, respiring cells bound to said chemical functionality.

41. A composition as recited in Claim 33, wherein said polymer is selected from the group consisting of acrylate polymers, aromatic polymers, polyimides, polycarbonates, and polysulfones.

42. A composition as recited in Claim 33, wherein said polymer comprises a polysulfone.

43. A composition as recited in Claim 33, wherein said polymer comprises poly (methyl methacrylate).

44. A composition as recited in Claim 33, wherein said pattern comprises a DNA microarray, an antibody microarray, or an antigen microarray.

45. A composition as recited in Claim 33, wherein said pattern comprises a three-dimensional microstructure.

44. A composition as recited in Claim 33, wherein said pattern comprises a microfluidic device.